

Appendix A

ASSESSMENT OF RENOVATIONS

**Bridgewater Elementary School
500 South Street
Bridgewater, Massachusetts
August 2003**

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Remediation activities were conducted by the Bridgewater-Raynham Regional School District (BRRSD) to address recommendations made in an MDPH IAQ assessment report released in November 1999 (MDPH, 1999). BEHA staff had visited the building and issued a report that made recommendations to improve indoor air quality and remediate water damage/mold issues.

The following is a summary of remediation efforts taken on MDPH recommendations provided in the Bridgewater Elementary School (BES) Indoor Air Quality Assessment Report issued in November 1999 (MDPH, 1999) with regard to the extensive water damage noted in that report. This summary is based on reports from Bridgewater-Raynham Regional School District (BRRSD) officials, school maintenance staff, and documents, as well as photographs and observations made by BEHA staff.

Mr. Feeney examined the BES after excessively humid weather occurred during the first three weeks of August 2003. Relative humidity in excess of 70 percent can provide an environment for mold and fungal growth (ASHRAE, 1989). In the experience of BEHA staff, excessively humid weather can provide enough airborne water vapor to create adequate conditions for mold growth in buildings. In general, materials that are prone to mold growth can become colonized when moistened for 24 to 48 hours or more (US EPA, 2001; ACGIH, 1989). Since hot, humid weather persisted in Massachusetts for more than 14 days during the month of August (The Weather Underground, 2003), materials in a large number of schools and buildings were moistened for an extended period of time. Many other school buildings in Massachusetts were closed due to mold colonization. In contrast, the BES lacked water damaged or mold colonized building materials after this

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extended hot, humid weather. The lack of mold colonization indicates that many of the steps taken by BRRSD staff prevented mold growth in the building under weather conditions most favorable for indoor growing mold.

At the time of the 1999 assessment of the BES, a number of condensation generation problems within the building directly related to the operation of the heating, ventilating and air-conditioning (HVAC) system in its air-conditioning mode were identified. Prior to the beginning of 2003-2004 school year, Mr. Feeney returned to the BES to conduct a re-assessment. On August 20 and 21, 2003, Mr. Feeney examined classrooms throughout the building. The following remedial efforts were taken by the BRRSD in regard to BEHA recommendations to prevent the generation of condensation and remediate mold growth:

1. Mold-colonized pipe insulation was removed from all ceiling plenums in the ground floor classrooms (Picture 3).
2. Water damaged ceiling tiles were replaced.
3. Carpeting was replaced with floor tile in classrooms.
4. Chilled water pipes connecting each unit ventilator (univent) were disconnected from the chiller of the HVAC system (Picture 4). This action eliminates the major source of condensation in the building.
5. Drainpipes connected to the drain pans of univents were also disconnected (Picture 5).

Mold colonized pipe wrap was identified during the initial assessment. The wrap had not been removed from pipes in three rooms on the top floor (Picture 6). This pipe wrap extends behind a bookcase that was attached to wall mounted radiators. BEHA staff

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recommended that this insulation be removed, and accumulated materials should be removed from the radiator fins.

In addition to removing mold colonized building materials and decommissioning the chilling capacity of the HVAC system, BRRSD staff identified a number of sources of rainwater penetrating through the exterior walls of below ground classrooms that are located closest to the school parking lot. The school is configured into three wings in the shape of the letter “E” (Map 1). The parking lot is located on a slope above the schools courtyards, effectively directing rainwater into the courtyard towards ground floor classrooms. The following remedial efforts for improving rainwater drainage and preventing mold were accomplished by the BRRSD:

1. A gutter and downspout system was in the process of being installed along roof edges (Picture 7).
2. The parking lot was re-graded to direct groundwater away from the building (Picture 8).
3. The apron along the edge of the building was repaired to prevent water accumulation.
4. Doors were installed in interior walls of classroom below grade of the courtyard slopes to allow staff to observe any water penetration through the foundation.

In addition to these remedial actions, BEHA staff recommended two additional remedial actions:

1. Use an alternative wall material that is moisture resistant (e.g., green board, which is used for adhering tiles in a bath tub or shower) in place of gypsum wallboard to prevent mold colonization, especially in classrooms that were

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prone to water damage. Gypsum wallboard is covered with paper that can be prone to mold colonization if repeatedly moistened.

2. Contour the slopes in the courtyard to direct rainwater away from exterior walls (Picture 9).

During the course of this renovation, BRRSD staff reported a source hindering the function of the original exhaust ventilation system. BRRSD staff discovered that screens to prevent insect access into the vents (e.g., bug screens) were installed on the exhaust vents. To prevent the nesting of birds and bats, a screen is frequently affixed around the opening of the exhaust vent (e.g., a bird screen). The mesh size should be of a sufficient size to allow the free flow of air from the exhaust vent, but small enough to prevent birds and bats from roosting in the vents (frequently 4 mesh per square inch). A bug screen for an openable window is required by the State Sanitary Code to have a minimum of 16 mesh per square inch (105 CMR 410.551). The installation of bug screen mesh over the exhaust vents was found by BRRSD staff to severely restrict airflow from the exhaust ventilation fans, which prevented the ventilation of water vapor and resulted in air and water vapor backdrafting into the BES. The installation of the bug screens on the exhaust vents rendered the BES without a functional exhaust system. Without a functional exhaust system, retention of water vapor inside the building would be enhanced and result in the increased likelihood of condensation on cold (e.g., below dew point) surfaces during hot, humid weather. This problem with the exhaust system may also have affected the indoor air quality parameters (e.g., carbon dioxide, temperature and relative humidity) measured by BEHA staff during the 1999 IAQ assessment. BRRSD staff reported that the bug screens were replaced with bird screens.

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Conclusions/Recommendations

Based on BEHA staff observations during the renovation effort, it appears that actions taken by the BRRSD have removed mold-contaminated materials. BRRSD has taken measures to both remove colonized materials and remove/repair potential sources of moisture that was responsible for microbial growth. These measures were consistent with recommendations made previously by BEHA staff as well as a variety of mold remediation guidelines. Other measures to prevent future water damage/mold growth to the school building components have also been taken. In view of the findings at the time of the assessment, the BEHA makes following recommendations:

1. Remove mold colonized pipe wrap from pipes in three rooms on the top floor (Picture 6). This pipe wrap extends behind a bookcase that was attached to wall mounted radiators.
2. Contour the slopes in the courtyard to direct rainwater away from exterior walls (Picture 9).
3. Considering using an alternative wall material that is moisture resistant (e.g., green board, which is used for adhering tiles in a bath tub or shower) in place of gypsum wallboard to prevent mold colonization, especially in classrooms that were prone to water damage.
4. Consult “Mold Remediation in Schools and Commercial Buildings” published by the US Environmental Protection Agency (US EPA, 2001) if future mold growth should appear. Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.

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References

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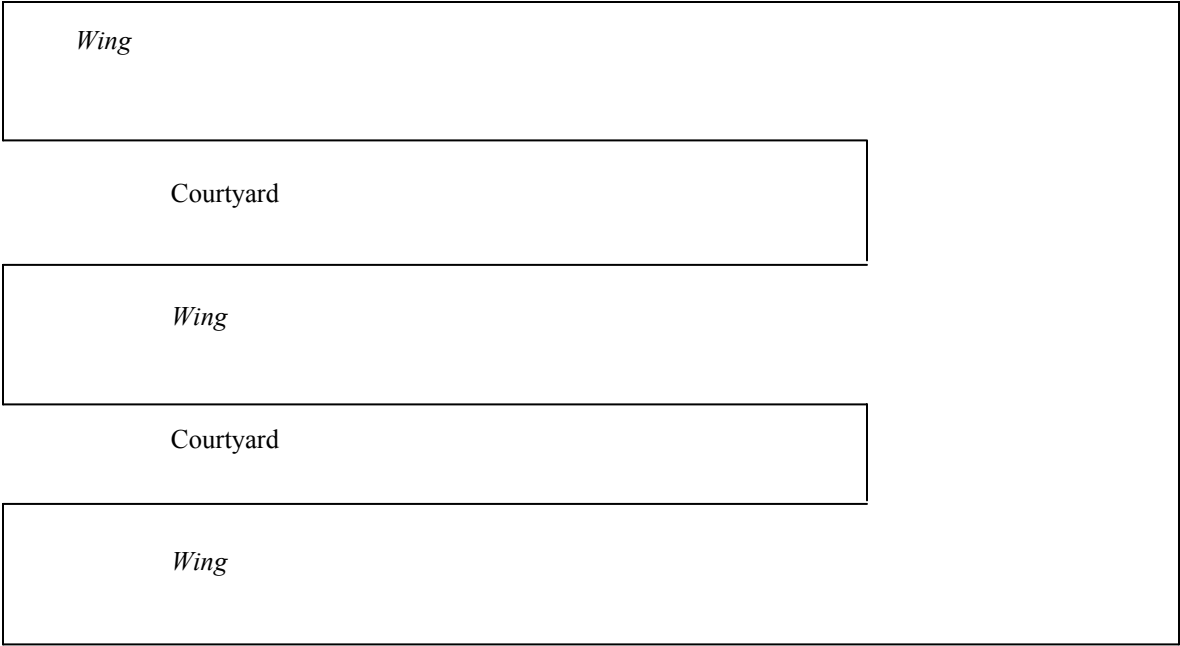
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Map 1

Configuration of the Bridgewater Elementary School

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Property Sloping Downward

A horizontal arrow pointing to the right, indicating the direction of the slope.

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Picture A-1



Example of New Pipe Insulation in Ceiling Plenum above First Floor Classrooms

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Picture A-2



Disconnected Chilled Water Pipes

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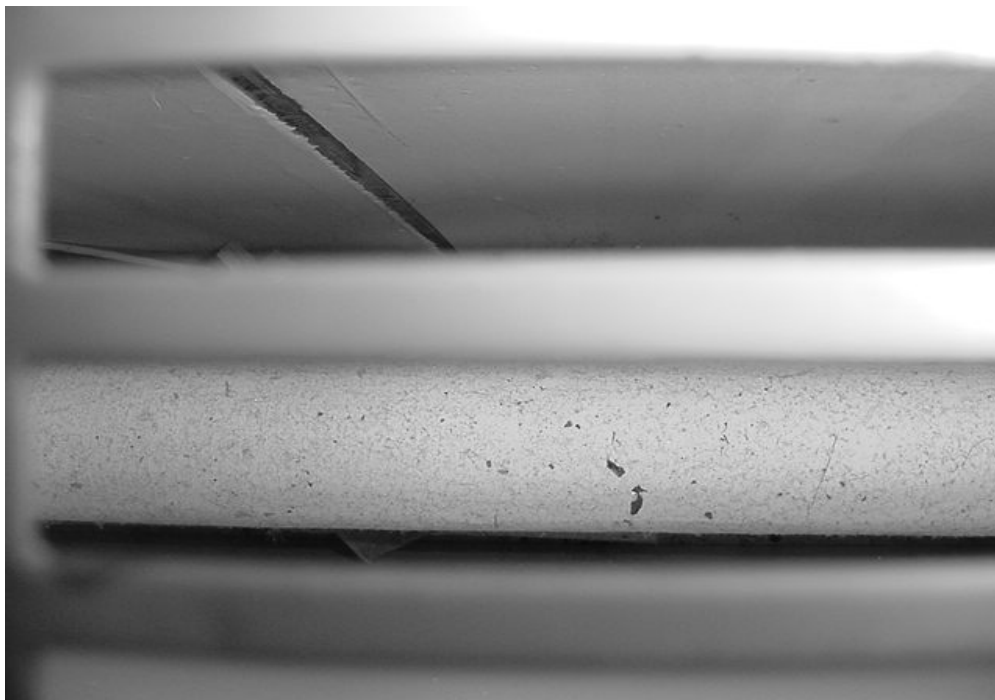
Picture A-3



Disconnected Drain Pan Drainpipes

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Picture A-4



Pipe Insulation in Southwestern Most Classroom at the Front of the BES

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Picture A-5



Gutter/Downspouts Laid Out For Installation on Roof Edge

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Picture A-6



Re-grading Of the Parking Lot In The Front Of the BES

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Picture A-7



Example of a Sloping Courtyard at the BES